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ENGL 3 Quiz 1

Question 1

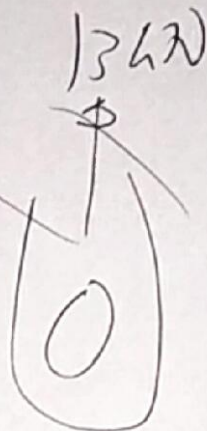
$$D_{\text{bolt}} = 16 \text{ mm}$$

$$\frac{136 \text{ N}}{2}$$

$$V = 15000 \text{ N}$$

$$R_y: 13000 \text{ N} - 2V = 0$$

$$V = 6500 \text{ N}$$



500 N 13000 N



Question 2 Mobd



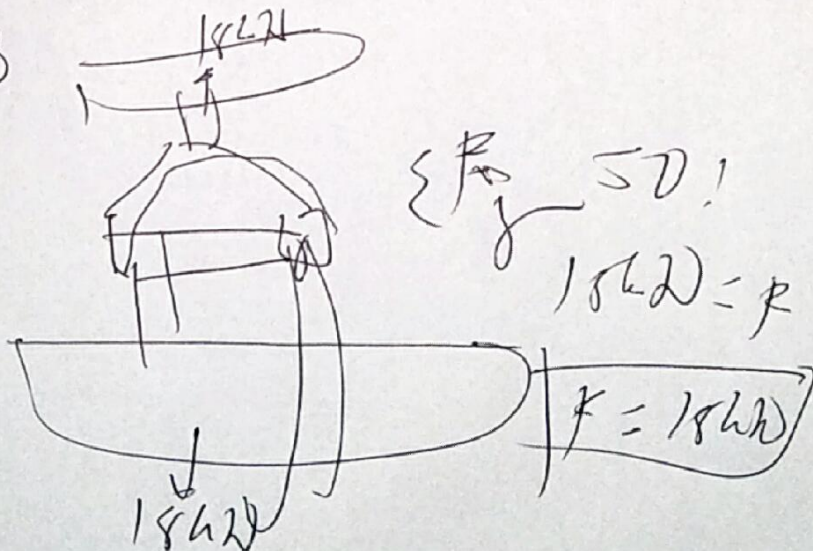
Bozva

$$\sigma = \frac{F}{A} = \frac{20000}{\pi (0.01)^2} = 119.95 \text{ MPa}$$

~~Question 3~~

$$\sigma = \frac{F}{A} = \frac{20 \text{ kN}}{A(2)^2} = 176.8 \text{ MPa}$$

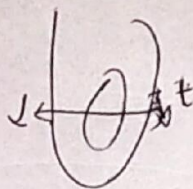
Quotient 3



Question 4

$$t = \frac{\frac{21}{2} \text{ MN}}{\pi(16)5} = 41.78 \text{ MPa}$$

Question 5



$$\sigma_b = \frac{14/2 \times 1000}{5(16)} = 87.5 \text{ MPa}$$

Question 6

$$\tau_{allow} = \frac{\sigma_{tens}}{F.S.} = \frac{120 \text{ MPa}}{2.2} = 54.55 \text{ MPa}$$

Question 7

$$\sigma_{allow} = \frac{\sigma_{fail}}{F.S.} = \frac{300 \text{ MPa}}{2.2} = 136.36 \text{ MPa}$$

Question 8

$$\sigma = \sigma_{max} = \frac{200}{2.4} = 125 \text{ MPa}$$

$$\tau = \tau_{max} = \frac{120}{2.4} = 50 \text{ MPa}$$

$$50 \text{ MPa} = \frac{P}{120(25)} = \boxed{31250 \text{ N}}$$

Question 9

$$\frac{0.185}{0.00125}$$

$$\frac{0.00125}{0.00125}$$

$$\epsilon_x = \frac{0.185}{300} = 516.67 \times 10^{-6}$$

$$\epsilon_y = \frac{-0.00125}{12} = -12.5 \times 10^{-6}$$

$$\nu = \frac{-\epsilon_y}{\epsilon_x} = 0.3145 \quad \epsilon_z = \frac{\Delta z}{100} = ?$$

$$\nu \epsilon_x = -\frac{\Delta z}{100} \Rightarrow \boxed{-\Delta z = 0.016 \text{ mm}}$$

Question 10

$$V = -\frac{\epsilon_2}{\epsilon_1} = 0.3145 = \boxed{0.31}$$

Sub question 7

Question 11

$$G = \frac{P}{2(1+V)}$$

$$\sigma = \frac{P}{A} = \frac{131000}{(12)(100)} = 109.1667 \text{ MPa}$$

$$\sigma = E \epsilon \Rightarrow E = \frac{\sigma}{\epsilon} = \frac{109.1667}{516.62 \times 10^{-6}}$$

$$E = 211.289 \times 10^3 \text{ MPa}$$

$$V = -\frac{\epsilon_2}{\epsilon_1} = 0.3145$$

$$G = \frac{211.289 \times 10^3}{2(1+0.3145)} = 80368.58 \text{ MPa}$$

$$G = 80368.58 \text{ MPa}$$

Question 12:

$$\sigma = \frac{136000}{100(12)} = 113.3333 \text{ MPa}$$

$$\sigma = E \epsilon \Rightarrow \epsilon = \frac{\sigma}{E}$$

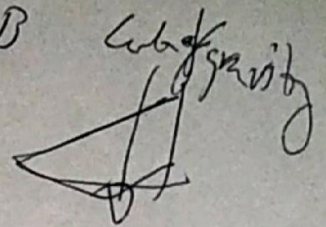
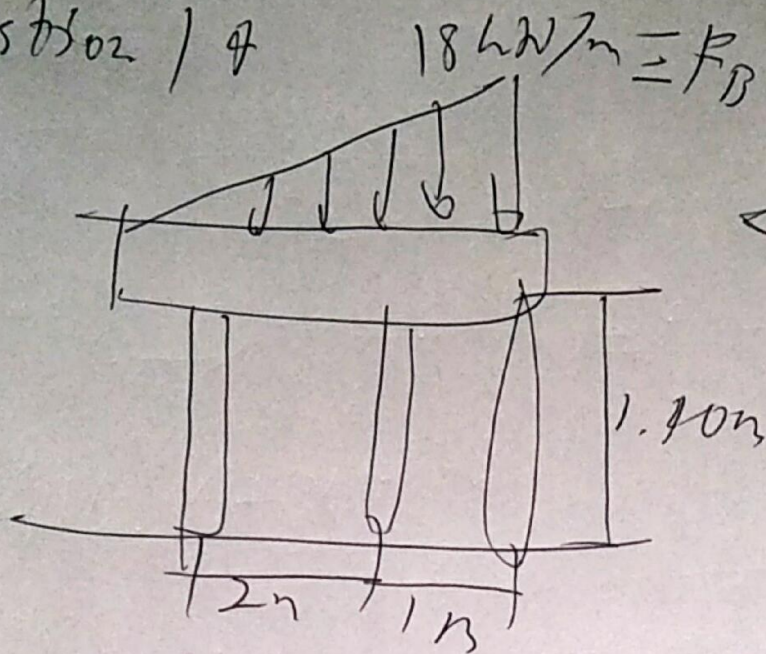
$$\epsilon = 516.67 \times 10^{-6}$$

$$F = \frac{113.3333}{516.67 \times 10^{-6}} = 219353.36 \text{ MPa}$$

Question 13:

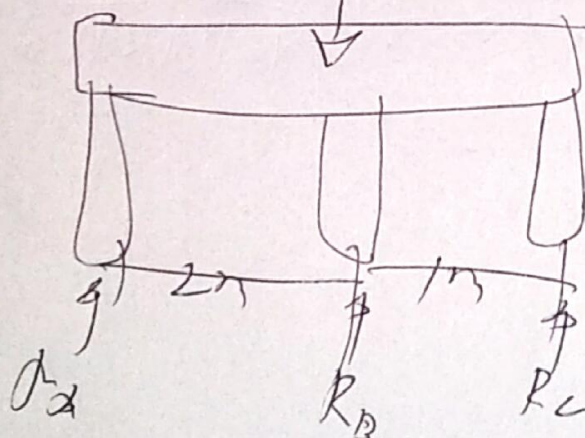
$$\sigma = \frac{135000 \text{ N}}{(20)(100 \text{ mm})} = 115.83 \text{ MPa}$$

Question 1/4



$$F_D = (18 \text{ kN/m}) (3m) = 54 \text{ kN}$$

$$F_D = 54 \text{ kN}$$



$$\frac{\sum C}{1} = \frac{\sum A}{2} \Rightarrow \sum C = 2 \sum A$$

$$m_A = 0: 54(2) - 2R_D - 3R_C = 0$$

$$m_C = 0: 54(1) - R_D - 3R_A = 0$$

$$\frac{P_C L_C}{\cancel{L_C} \cancel{P_C}} = 2 \left(\frac{P_A \cancel{L_A}}{\cancel{L_A} \cancel{P_A}} \right)$$

$$R_C = R_D = 2R_A = 2R_A \Rightarrow R_A = \frac{R_C}{2}$$

$$54(2) - 2R_D - 6R_A = 0$$

$$54(1) - R_D - 3R_A = 0$$

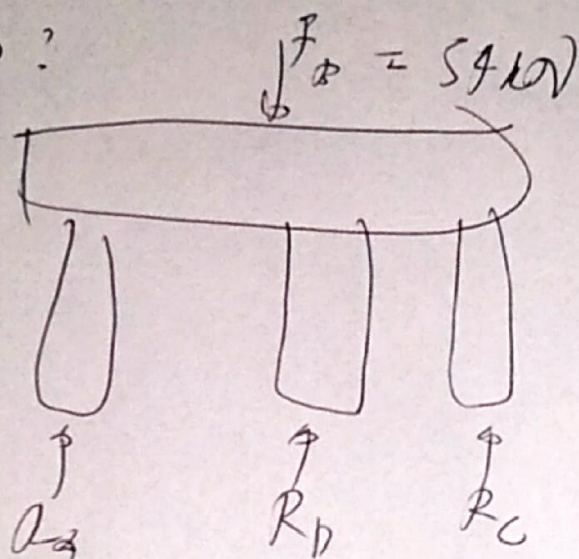
$$54(2) - 2R_D - 6R_A = 0$$

$$-54(4)(2) + 2R_D + 6R_A(2) = 0$$

$$2 \int_D = 3 \int_C$$

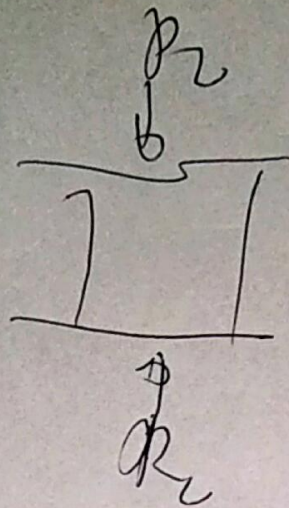
$$2 R_D = 3 R_C \Rightarrow \frac{2}{3} R_D = \frac{3}{2} R_C$$

$$\langle R_D = 0 ?$$



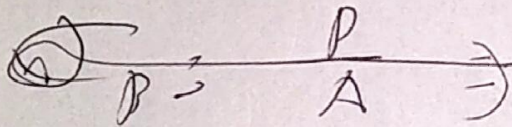
$$F_D - \frac{R_C}{2} - \frac{3}{2} R_C - R_C = 0$$

$$F_D = 3 R_C \Rightarrow R_C = 18 \text{ kN}$$



~~$\sigma_L =$~~ $\sigma_L = \frac{18000}{\pi \left(\frac{75}{2}\right)^2} = \boxed{4.07 \text{ MPa}}$

Question 15:



$$R_B = \frac{3}{2} R_L = 27000 \text{ N}$$

$$\sigma_B = \frac{27000}{\pi \left(\frac{75}{2}\right)^2} = \boxed{6.11 \text{ MPa}}$$

Question 16:

$$R_A = \frac{R_C}{2} = 1000 \text{ N}$$

$$\sigma_x = \frac{3000}{A \left(\frac{75}{2}\right)^2} = \boxed{2.04 \text{ MPa}}$$

Question 17:

$$\epsilon_A = \left(\frac{PL}{AE}\right)_A = \left(\sigma \frac{L}{E}\right)_A$$

$$\epsilon_A = 2.04 \left(\frac{1.40 \text{ m}}{12 \times 10^3}\right) = 23.8 \times 10^{-6}$$

$$\epsilon_A = 0.0238 \text{ mm} = \boxed{0.02 \text{ mm}}$$

Question 18:

From Question 14:

$$F_B = -\frac{R_C}{2} - \frac{3R_C}{2} - R_C = 0 \Rightarrow F_B = 3R_C$$

$$\frac{F_B}{3} = R_C \text{ Since } F_B = 50 \text{ kN}, \boxed{R_C = 18 \text{ kN}}$$

Question 15
[Power Problem]

$$R = 200 \text{ } \Omega$$

$$\omega = 11.7 \times 10^4 \text{ rad/s}$$

$$A_1 = 360 \text{ nm}^2$$

$$R = 49 \text{ } \Omega$$

$$\omega = 2\pi \times 10^4 \text{ rad/s}$$

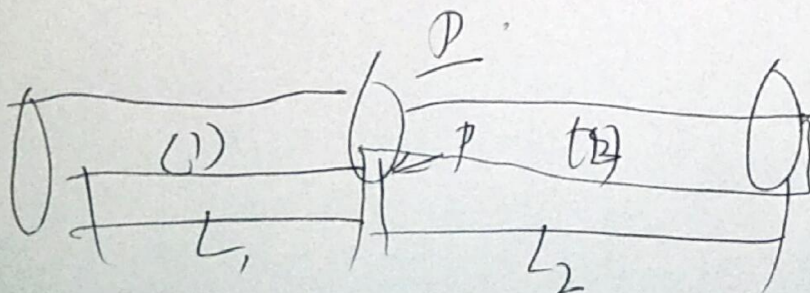
$$A_2 = 2750 \text{ nm}^2$$

$$L_1 = 4.2 \text{ m}$$

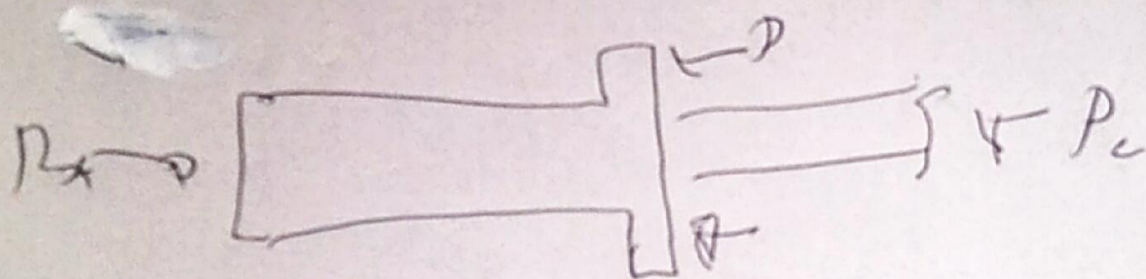
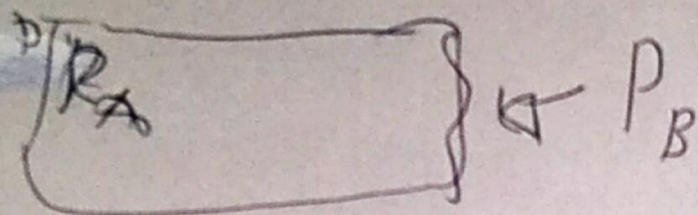
$$L_2 = 6 \text{ m}$$

$$T_0 = 250 \text{ }^\circ\text{C}$$

$$P = 60 \text{ W}$$



$$2P = 120420$$



$$P_B = 120000 + P_L$$

$$\frac{(120000 + P_L)(4.2)}{(3260)(200 \times 10^3)} + \frac{23.6 \times 10^{-6}(\Delta T)(4.2)}{(2750)(200 \times 10^3)} \\ = \frac{P_L(6)}{(2750)(200 \times 10^3)} + \frac{23.6 \times 10^{-6}(\Delta T)(6)}{(2750)(200 \times 10^3)}$$

$$\frac{\phi_2 (6)}{(2750)(200 \times 10^3)} + 23.6 \times 10^{-6}$$

Since $\phi_2 = 0$:

$$\frac{(12000)(4.2)}{3200 \times 200 \times 10^3} + 11.7 \times 10^{-6} \Delta T (4.2)$$

$$= 23.6 \times 10^{-6} \Delta T (6)$$

$$\Delta T = 7.5708^\circ\text{C}$$

$$35 + 7.5708 = 42.5708^\circ\text{C} = \boxed{42.57^\circ\text{C}}$$